The intriguing life of massive galaxies
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Gas, dust and star formation in nearby galaxies as seen with the JCMT

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We presented results using the Nearby Galaxies Legacy Survey (NGLS), which is being carried out with the James Clerk Maxwell Telescope (JCMT) on Mauna Kea in Hawai'i. We have obtained CO $J = 3 - 2$ data for 155 nearby galaxies to trace the dense molecular gas in which stars are believed to be born. The sample of this survey covers a wide morphological range and has been selected to include galaxies that have been thoroughly studied in the literature, and for which abundant observational data are available. In parallel, we have observed the same sample of galaxies using the Hα spectral line, which traces massive star formation.

Using these data and infrared (IR), far-ultraviolet (FUV) and atomic hydrogen data from the literature, we analysed and discussed the distribution of star formation and gas in the nearby galaxy M 81, an object showing very little CO content (limited to some regions in the spiral arms) but enhanced star formation. We find a strong correlation between the different tracers of star formation both at a global scale and in the small detail. A correlation between CO and star formation is also found, but is much weaker.

We also presented a study of the massive star formation across the NGLS sample by using our Hα imaging and deriving star formation rates (SFRs) and equivalent widths (EWs). We find an overall SFR of $0.25\,M_\odot\,\mathrm{yr}^{-1}$ for the whole sample, which is slightly lower than other values found in comparable previous studies. Average SFR values for different subsamples show strong variations, from $0.1\,M_\odot\ \mathrm{yr}^{-1}$ for Virgo galaxies to $0.6\,M_\odot\ \mathrm{yr}^{-1}$ for large spirals. EWs are in the range of $1 - 880$ Å with a median value of 27 Å. We find a significant correlation between SFR and B-band luminosities, although our different subsamples show disparate behaviours. There is no correlation between EW and luminosity. A weak trend is found with morphology, with late spiral and irregulars showing higher EWs.

We combined CO $J = 3 - 2$ luminosities and Hα SFRs for the whole sample and find a good correlation, similar to previous studies that used lower transitions in the CO line. Several groups of galaxies, including M 81, show a peculiar behaviour in the SFR(Hα) $- L_{\mathrm{CO}\ J=3-2}$ plot, which disappears when using IR data. We analysed these regions and propose several hypotheses to explain this behaviour, including group interactions and very recent ($\lesssim 20\,\mathrm{Myr}$) bursts of star formation only traced by Hα emission. While atomic hydrogen is hardly related with SFR, molecular and total gas (H I $+H_2$) show similar correlations with Hα luminosities. No correlation is found between CO $J = 3 - 2$ luminosity and metallicity, although galaxies with low metallicity are more likely to remain undetected. Although CO $J = 3 - 2$ does not seem to be a significantly better tracer of the star-forming gas, its independence on metallicity may be used to constrain the conversion factor between CO and H_2.

Finally, we presented an ongoing project aimed to obtain continuum-subtracted Hα imaging for a large area of the Hercules Cluster (Abell 2151) using the Isaac Newton Telescope on La Palma. Additional data in several optical bands (u, g, r, i, z) are currently being acquired using the VLT Survey Telescope (VST). Using this variety of data, we aim to study the morphology, SFR and EW of the galaxies in the cluster across different environments.